Conceptual design of a fission product generator as a continuous source for radionuclides with short and medium half-lives

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Model experiments for chemical separations of the transactinides have traditionally been performed with carrier-free radioisotopes of homologue elements produced in reactors or at accelerators. Therefore, the availability of such tracers is limited; they are expensive and not always available in the chemical and physical form needed.

An alternative is the use of fission products provided by a radionuclide that decays at least partially by spontaneous fission. ^{252}Cf ($T_{1/2}$ = 2.645 y) is a well-suited isotope for this purpose. Among its fission products are many isotopes of the homologue elements of the transactinides.

A device for the collection of short-lived ^{252}Cf fission fragments has been previously constructed and successfully used in many experiments [1]. Further studies showed that the yield of the generator and its capabilities could be drastically improved by adding the possibility of collecting longer-lived fission fragments [2]. For this purpose a new generator with improved reliability was designed.

The centerpiece of the generator is a ^{252}Cf source (4 µg) plated onto a metal disc. The source is placed in a holder at the tip of a rotating arm. This arm can move between three different positions. The first position allows for the collection of short-lived radionuclides in a gas-filled recoil chamber. From here the recoils can be transported to different experimental setups using an aerosol gas-jet. The second position allows for the collection of longer-lived fission products by implantation on a removable catcher foil. The third position can be used for the safe storage of the source during non-operation of the generator. The assembly containing the source, recoil chamber and catcher foil will be located in a primary and secondary containment in the center of a large cube of borated polyethylene shielding.

This device will provide an inexpensive way to produce carrier-free radionuclides on demand. It will not only be useful for heavy element research but also well suited for universities and for the training of students in radiochemical techniques.

Footnotes and References

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1. Ch. E. Düllmann et al., accepted for publication in Nucl. Instrum. Meth. A

2. R. Sudowe, J. B. Patin, LBNL/PUB-5473 (2001)

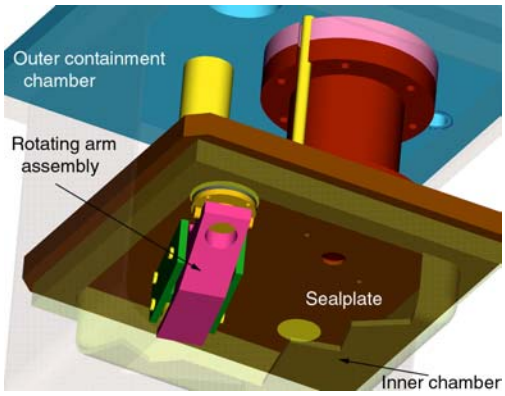

Fig. 1. Bottom cutaway view of the inner and outer chamber with seal plate, recoil chamber and rotating arm.

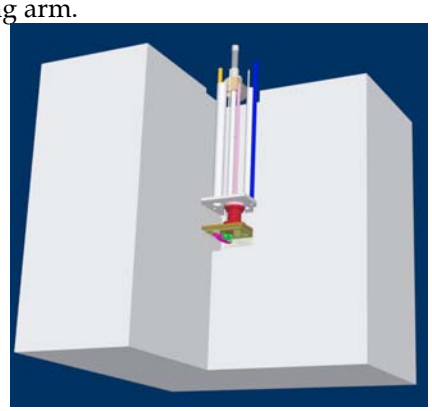

Fig. 2. Side view of the complete assembly with transport and supply tubes. The containment with the rotating arm including source holder and recoil chamber is embedded in the center of the polyethylene shielding.